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THE EXTERNAL EXAMINATION

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The External Examination has always been accorded first place in the routine of examination. Various clinicians adopt varied methods of obtaining ocular data, but in all instances the external examination is included. Optometry has built in the past few years a compendious routine which, if employed intelligently, yields a vast insight into the patient's visual condition. The professional journals carry articles on some facet of the examination in nearly every issue. It is evident, however, that the particular phase of work dealing with the determination of the normalcy of the external parts of the eye and the fundamentals of vision has been grossly neglected. It is not to be assumed that the subject has been covered so thoroughly that there is no room for improvement. True, in recent years the addenda to the technique have not been quite as voluminous as those applied to other parts of the routine. But is this not actually due to the neglect with which the subject has been treated, rather than any dearth of research material in the subject itself?

Before proceeding into a description of the tests which should be incorporated into a complete examination of the eye, let us review the several benefits to be derived from their employment. These being manifold, it will suffice if we mention only a few of the most important reasons for employing a full and complete external examination. For our first consideration we have—the value of the data obtained. No other part of the examination is of greater use to us in determining the final treatment extended the patient than this. It is perhaps needless to mention that the value of any portion of the examination varies directly as the attention given it. If in our routine, the external examination is relegated to a minor position and constitutes a very meager portion, it is to be expected that the data obtained from it will be of slight practical value. It is no means rash to state that if employed properly, this section will yield fully as much value in the final judgment as any other isolated division of the examination. A second and fully as cogent reason for advocating the use of this examination is the psychology of dominating the patient. Psychologists are agreed that whenever two individuals are brought together in close relationship, one must as-

sume command of the situation and dominate the other. By domination we do not mean bullying, but rather control and authority. According to all standards it is immediately apparent that the Optometrist should be the dominant figure during the course of the examination, and in keeping with this line of reasoning it is imperative that this control be established and maintained from the start. No great exercise of ratiocination is needed to see how a properly conducted external examination may be conducive to this result. The third reason is not nearly as conclusive as the others, but may aid in finally influencing some to attempt the introduction of this diagnostic aid into their armamentarium—no accessory instruments are required for its successful employment, besides those already found in every refracting room. This last reason may seem beside the point, but it certainly renders invalid any objection to the use of the following tests. Time, of course, is a vital factor, though not as much as formerly, but when a definite method is followed in obtaining this data, time does not enter into consideration as it is not encroached upon.

The routine of the external examination as given in this paper is the result of several years of clinical experience at the Pennsylvania State College of Optometry and practical experience in the offices of various Alumni. It has been subjected to many strains and stresses, and has suffered material change in make-up and the relative importance of the tests, but in the form as given here is practically invulnerable.

The external examination may be divided into three parts, each separate and distinct from the others. This division is not made arbitrarily, but by reason of the fact that each division involves the use of one or more techniques peculiar to it. These divisions are: Inspection, Palpation and Functional Tests. We shall now discuss them in the order given.

Inspection.

Inspection simply means viewing with care the appendages and external parts of the eye. It may be accomplished by three methods. In actual practice it is sometimes expedient to use one method, and sometimes another. These methods are: Magnification, *i.e.,* view the structures through a plus 13.00 D. lens held about two inches from the eye; Oblique Illumination produced by holding a transilluminator or any concentrated source of light along the side of the temple at right angle to the visual line; Slit Lamp, which is merely a combination of high magnification with intense illumination. The hand slit lamp is very well adapted for this type of work, as it does not consume nearly the amount of time necessary for the operation of the large variety. Assuming we have finished with the oral examination of the patient and are acquainted with their symptomatology we are ready to commence inspection.

We start our examination by noticing the facial characteristics

of the patient, noting in particular the Pupillary Distance, nature of Eyebrows, amount of pigmentation and in general, the regularity and symmetry of the features. It is in fact a summation of the individual as to intelligence, character, energy, etc. We next proceed by means of magnification to examine the Palpebrae or Eyelids noticing carefully the color, thickness (whether oedematous or natural), position and size of the palpebral fissure, observing the amount of visible sclera. The margins of the lids are examined to determine if they are ulcerated or if the typic crusts of blepharitis marginalis are present. Requesting the patient to close their eyes we note the responsiveness of the nervous control of the lids, whether the act of closure is spontaneous, rapid and complete. The direction of the cilia or lashes is very important, since their misdirection is a prolific cause of conjunctivitis.

It has been found best to start, as we have, at the most anterior of the ocular appendages and work backward into the more internal structures. In accordance with this we next come to the conjunctiva. Covering the palpebral and bulbar conjunctiva and the retro-tarsal fold thoroughly we note the color, smoothness and conspicuousness of the blood-vessels. If any secretion is present besides the normal slight amount of lachrymal fluid we estimate the amount and character. Whether the upper lid should or should not be everted is a decision for the individual case. If the patient appears hysteric or neurotic it is only an aggravation and will not be of much assistance. Eversion of the lower lid being produced by slight traction on the skin below the lid may be performed in every case. If the conjunctiva should appear normal, eversion of the upper lid may be dispensed with; but if the least suspicion exists the lid should be everted.

Proceeding to the eyeball proper we examine the cornea employing all three methods for best results. If any opacities are present we should determine their extent and location in view of their possible interference with vision. If the cornea exhibits any vascularization, *i.e.*, the pannus of trachoma or the salmon patch of interstitial keratitis, we receive a very valuable warning to proceed cautiously with the remainder of the examination. Needless to say in our inspection of the cornea we should look very closely for foreign bodies, as in many instances foreign bodies have been found without any accompanying inflammation. The polish and regularity of the corneal curves may be readily examined by noting the reflection of a distant illuminated object on the cornea.

Immediately back of the cornea is situated the anterior chamber, which is examined carefully by oblique illumination for any sediment reposing in the aqueous humor. The depth of this chamber should be carefully noted, by reason of its frequent change during the progress of diseases affecting the ocular humors.

The color and marking of the iris are the next points of interest in our pursuance of this examination. By oblique illumination we

determine whether the characteristic roughened surface is present, judging the degree of roughness by the depth of the shadows cast. In quite a few cases a tremulousness of the iris during ocular rotations will be observed and should be noted immediately. The pupil being formed by the iris should be scrutinized as to shape, size and position. With oblique illumination and the Slit Lamp the anterior portion of the lens can usually be observed and any abnormal haziness noted. This, of course, should be verified by the use of the Ophthalmoscope.

Since the advent of efficient transillumination, the examination of the sinuses, antra and teeth has become a permanent part of the external examination. In attempting this the examiner should be certain that his transilluminator is efficient, as some devices on the market make a certain diagnosis next to impossible. As the method of transvisualization varies with the instrument employed it will not be discussed in this paper. This concludes the inspection of the eye and we now pass on to the second part of the external examination.

Palpation.

Palpation, or the examination by pressing the fingers upon the suspected organ is of considerable value. Due to the delicate nature of the structures involved the digital pressure should be slight and well controlled. The principal use of this method is the determination of the amount of intra-ocular pressure or tension of the eyeball. A slight fluctuation from normal may exist without serious trouble, but when we realize that among other things a low pressure may indicate progressive myopia and a high intra-ocular pressure glaucoma; it behooves that we be informed on this point. The technique is performed by having the patient look downwards with the eyes closed, and gently pressing the sclera above the cornea with the index fingers placed upon the upper lid. The examiner should first become acquainted with the normal pressure by examining quite a few healthy eyes, and then any departure from normality will become readily apparent.

Regurgitation or the forcing back of the fluid from the lachrymal sac through the puncta, and observing the character of the secretion as it appears at the inner canthus, should be employed if any malfunctioning of the lachrymal system is suspected. It is performed by placing the index finger about one-half inch below the inner corner of the eye and pressing sharply down and back. This empties the sac and forces the contents through the puncta where they may be readily examined for purulence. This test may, of course, be performed in a small amount of time.

Functional Tests.

It has become customary to include various tests of the ocular functions under the external examination. It is quite apparent that a paper of this sort can not possibly give a complete discussion of

some of the tests mentioned under this heading. Fortunately, Optometry has some literature on this portion of the external examination, and to it the reader who desires complete information is referred. A cursory glance at each step must suffice us at present.

The examination of the light sense may be conducted by means of a rheostatic control of the lamps on the test chart, though if a detailed investigation is required the use of Forster's photometer is recommended. The form sense being measured by the visual acuity, it is only necessary to mention it in passing. The lantern or color-slides on the test chart will give us a clear conception of the functioning of the color sense. If, after this partial examination of these functions any should appear abnormal, further study of them should be made.

The cover test made by occluding one eye for a time, and then watching its motion when the cover is removed, gives a vital indication of the muscular equilibrium of the eyes. Remember in making this test, that the motion is always the opposite the deviation. To further this, the rotations and versions of the eyes in the four cardinal directions should be measured by having the patient follow the fingertip up, down, in and out. Convergence should also be tested at this time, and the evenness of movement as well as the amount should be recorded.

The pupillary reactions are next taken. The reaction to light is easiest determined by placing the transilluminator at the side of the temple so that the eyes are shielded from its light. Then move the instrument slowly forward until it casts its rays into the eye, observing the action of the pupil during this procedure. The consensual reaction of the opposite eye may be observed at the same time. The pupillary reaction to accommodation and convergence is obtained by having the patient gaze upon the tip of the finger at about one meter distance. As the finger is moved slowly and steadily towards the patient's nose, the movements of the pupil are witnessed. In these, as in all other tests, when the examiner has become cognizant of a few normal cases he becomes very apt in detecting the abnormal.

Some clinicians include the taking of the form, color and paracentral fields under this heading, but as this constitutes a study in itself, it is only mentioned at this place.

Conclusions.

By way of conclusion it is intended to present several reasons why a complete external examination should form an inseparable part of the Optometric routine. These may conveniently be grouped under three sub-headings:

(a) *The data obtained during the examination is invaluable as an indicator of pathological conditions of the eye.* The significance of the discovery of an Argyll-Robertson pupil in a case of tabes dorsalis may be the means of referring the patient to treatment which

may check the disease at the present state of progression. An abnormal tension leading, with the aid of other symptoms, to a diagnosis of glaucoma may save hours of untold agony to a patient. The presence of iritis or possibly cyclitis, may be made in time to prevent the development of a possible panophthalmitis. These examples of the efficacy of the external examination in disclosing both ocular and general pathology could be multiplied ad infinitum.

(b) *The data obtained during the examination gives information of great help during the remainder of the examination.* The regularity of the corneal curves as determined by the observation of the reflex, may be of considerable aid in kratometry. The size and reactions of the pupil are particularly indispensable for the correct operation of the Tait Dynamic System; in addition to which, the investigation of the light sense affords a definite clue for the intensity of the skiascopic illumination. Clinical experience proves that apparently minute factors, such as these, determine the success or failure of the examination. The data derived from the cover and rotational tests, will prove of much value when the tonicities and ductions are taken.

(c) *The psychologic value of these tests in impressing the patient with the thoroughness and knowledge of the examiner can never be given its true valuation.* Dean Fitch frequently stresses this advantage of the external examination to the senior students, in the course on office practice at the Pennsylvania State College of Optometry. If the external examination is conducted in the proper manner, the Optometrist secures a control over the patient which paves the way to confidence and trust.

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A QUESTIONNAIRE ON THE ASSOCIATED FUNCTIONS OF CONVERGENCE ACCOMMODATION AND FUSION

In the effort to broaden our understanding of the associated functions of convergence and accommodation the following questions were sent to Dr. Arthur Hoare and several other men whose outstanding work in ocular myology makes their views on these matters of the utmost importance and we believe of the greatest interest at this time. We will publish in subsequent issues the views on these questions, of other of our practitioners.

The questions are as follows:

What is the relation between esophoria (excessive convergence) at the near point in the young adult and high exophoria (convergence lag) in the presbyope?

Is the one the forerunner of the other? That is, can we expect the young adult with excessive convergence at the near to have convergence lag of high amount at the near when he becomes a presbyope?

If not, why is it, that convergence excess at the near is the common imbalance found in the young while convergence lag is usually associated with the presbyopic period. Why is it, that the percentage of convergence excess cases found among young patients dovetails with the precentage of convergence lag cases found in the older ones? Why is it, that the young patient who shows a convergence excess is as a rule the ardent, energetic, "doer" type and this also holds true of the average presbyope who shows a convergence lag? Are these facts mere coincidence or do they point to the fact that convergence excess at the near in the young adult presages convergence lag in the prebyope?

If it can be demonstrated that the convergence excess of the young adult turns into the convergence lag of the older patient, what is to be done about it?

We know that uncorrected hyperopia, hyperopic astigmia, over corrections of minus, prism power base-out, wide interpupillaries and pathology cause excessive convergence. What other factors are causative?

Does a convergence excess at the near always keep company with a faulty, incomplete, or imperfect fusion sense?

If so, is it this lack of positive binocular fixation or anchorage, associated with faulty fusion, which permits the development of a

convergence lag when the accommodation no longer functions unaided at the near point?

Further, what factors contribute toward the conversion of a convergence excess into a convergence lag? We know that over-corrections of plus, especially reading corrections for presbyopes, and base-in prism power gradually bring about convergence relaxation, which can result in a convergence lag. What other factors produce this result? Do small segment bifocals tend to cause convergence lag by the disturbing effect they may have or near point fixation? Are large segments, conducive to easier near point vision when there is a convergence lag present?

If prism power base-in only tends to convert one distressing condition (convergence excess) into another (convergence lag) over a period of years, is it not questionable procedure to use such prism power either for wear or exercise without close and constant supervision of the case? Should not the use of such procedure always be accompanied by fusion training?

Is correction of a faulty fusion sense the surest and sanest way to establish comfortable ocular balance? If so, should not all orthoptic training stress the development of greater fusion power?

These questions are asked with the view of clearing up the haze surrounding the whole question of ocular imbalances. We believe that the group mind of our leading optometrists can solve the problems of ocular balance and set our feet upon the pathway of clarity and established facts.

Dr. Arthur E. Hoare reviews the above questionnaire and comments thereon in the pages immediately following. For the reader's convenience the following Reference List of previously published manuscripts in answer to this questionnaire is given:

Convergence, Accommodation and Fusion. Dr. I. S. Nott, American Journal of Optometry. Vol. 6, No. 1, pp. 19-29. 1929.

Convergence, Accommodation and Fusion. Dr. J. I. Pascal. American Journal of Optometry. Vol. 6, No. 2, pp. 102-104. 1929.

Convergence, Accommodation and Fusion. Dr. M. Steinfeld. American Journal of Optometry. Vol. 6, No. 3, pp. 169-171. 1929.

Convergence, Accommodation and Fusion. Dr. W. Bagwell. American Journal of Optometry. Vol. 6, No. 3, pp. 193-194. 1929.

CONVERGENCE, ACCOMMODATION AND FUSION.

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Any numerical relationship that has been found to exist at the working distance as between esophoria, in the young adult, and high exophoria, in the presbyope, is justified if on no other physiological basis than that connection which exists between the normal tone of the functions of the youth and those of the aged. If there were not a relationship as between these two ocular manifestations at these two chronological extremes it would be *more* significant than that there should be such a relationship.

Most esophorias in the young adult are due to uncorrected facultative hyperopia latent or manifest in whole or part. The physiological reasons for this convergence excess in such cases is too well demonstrated to need further comment. Any "manifest" phoria (manifest with fusion broken) is a sign that there has been a "postural tension" with an effective compensating stress going on, if single simultaneous binocular vision has been maintained. The particular phoria indicates the direction in which the antagonizing pull has had to be maintained. In the case of esophoria—the compensating stress has been exerted by the anti-converging muscles. It is invalid in this discussion to consider esophoria in the young adult unless we consider the uncorrected hyperopia as being compensated for by the faculty of accommodation. Certainly if there is—in any individual case—a close relationship existing as between accommodative effort and convergence effect—and an accommodative effort of considerable amount is being made, and further, if clear single simultaneous binocular vision has been obtained, there must of necessity be a fatigue *not* of the converging muscles—but of those muscles which are called upon to offset the excess convergence effect due to the excess accommodative demand for clear vision. That is to say—there must have been established a very facile inhibiting arrangement—otherwise diplopia would have ensued in those cases of relatively high facultative hyperopia in which there is a close reciprocal relationship in the two functions of accommodation and convergence. This facility of inhibition expresses itself through an increased innervational tone to the anti-converging muscles. Now, if this condition of uncorrected facultative hyperopia has gone on for twenty years (the young adult) it is quite conceivable that this same facility should readily manifest itself in the presbyopic stage as a high exophoria. In fact—it would appear to be logical, especially when most hyperopes in the presbyopic stage have had some form of accommodative relief through plus lenses—either for distance, near or both. To the extent of this relief of accommodative effort, convergence

is relieved of the associated stress, and the initial hyper-tonus of the anti-converging muscles, plus a compensating nervous pathway that has been schooled in the task of inhibiting convergence, persists, to the inevitable tendency of producing a facile exophoria at the working distance. In this respect I believe there is a close relationship as between esophoria in the young adult and the exophoria in the presbyope at the working distance.

If then it is the normal and natural condition to find esophoria in the young adult, and high exophoria in the presbyope, the one is the forerunner of the other, even as the exaltation of the youth in all motor manifestations is the forerunner of the degradation of all motor manifestations in the aged.

If, on the other hand, there is a specified significance in these two ocular manifestations, and I think the forestated reasons support such a theory, I think it is speculative to look for any overt significance in the matter of mental or motor types. It is agreed that the young adult who shows esophoria is of the "energetic type," but not all energetic young adults show esophoria. The explanation of any numerical relationship is not to be found in terms of "type"—but rather in terms of latent error, whether of the intrinsic optical or extrinsic muscular status of the eyes.

High exophoria in the presbyope has occurred in my practice with tantalizing promiscuity, and I am frank to admit that academic considerations of such a condition have led me into more "grief," than joy.

Of course, it all depends upon what is considered "high" exophoria. A violation of a numerical (mechanistic) standard in such a volatile thing as a physiological (psycho-physiological) function means little as clinical evidence, without reference to those factors having to do with the law of supply—both in its quantitative as well as in its qualitative phases.

If the esophoria in the young adult is due to latent exophoria with a consequent over stimulus of the converging muscles to meet this diverging tendency of the visual axes, and as a consequence there is set up a fatigue of the anti-converging muscles, the same end result is produced and a reason for a relationship as predicated in the questionnaire is likewise established, as in the case of the uncorrected facultative hyperope.

Further, if the esophoria in the young adult is due to excess "mental drive" (the psycho-physiological basis for what is often referred to as an "attention reflex" * * *)in which the mind demands for its satisfaction a meticulous fixation and focalization, there would ensue a relatively rapid exhaustion of the nervous resources serving such a highly toned binocular visual objective. This exhaustion might conceivably manifest itself in the presbyopic stage in the high exophoria, which it is sought in this questionnaire to associate with the esophoria of the young adult. In this case it would be a specialized

exaltation of function in the young adult, leading to a degradation of function, through exhaustion, in the aged.

As to what is to be done about it:

First—correct all the manifest hyperopia—and if there is no manifest, do everything possible to uncover the latent, and correct for it by one of the orthodox methods.

Second—correct for the manifest exophoria, with prism base-in to the amount of the manifest error—providing there is a relatively good abduction after the manifest has been taken care of.

Third—Suggest such hygienic measures to the patient whom you suspect of an excess "mental drive" as would tend to lower the degree of ~~con~~concentration. In a recent test on two young esophores, it was discovered that a longer time was consumed in reading a set piece of printed matter than was occupied by two young patients whose muscle balance was normal. The thought has occurred to the writer that we have a definite division of cases into (1) the "proof reader" type—which studies every detail, and (2) the "picture minded" type—which is content with a broad mental impression. Possibly a "reading time" test might give a clue to this classification.

"Does a convergence excess at the near always keep company with a faulty, incomplete or imperfect fusion sense?"

I see no connection.

Esophoria at near is an anomaly—imposing a very severe tax upon the mechanism of compensation (call it "fusion" if you wish—or possibly, the visual expression of the autonomic nervous system * * *) and because the imballance manifests itself as a phoria and not as a tropia I fail to see how that which holds the excess in check could, at the same time and by the same process, produce it.

"As to whether a high exophoria in the presbyope is a result of a 'lack of positive binocular anchorage associated with faulty fusion.'" I think not. There are other more clearly demonstrable causes.

For example: There are more young facultative hyperopes who do not show esophoria at the working distance than do show it. Further, there are more young facultative hyperopes who, when their manifest error is corrected, show no material change in the lateral balance—either at the distance or the working distance than do show such a material change, at the time of putting on the plus. These immediate adjustments of previous anomalous stresses as between the intrinsic and the extrinsic muscles must be affected by "the fusion faculty." Since the commonest type of refractive correction is plus —there is thus brought about a lessening of the accommodative effort, to the extent of the plus "accepted," while the converging effort is, to that extent, deprived of an equal amount of the accustomed and previously existing reciprocity as between accommodation and con-

vergence. This new relationship must predispose to a tendency for convergence to separate from accommodation, or to what is often called "lag of convergence." This is true of the distance relationships, but doubly true of the near. I regard as one of the cardinal sins of refraction the giving of plus corrections to every presbyope who comes in complaining of occasional and slight blurring at the working distance. While it is true that as we grow older there is needed a higher ratio of effort to produce a given effect—in every function of the body—but especially in the mechanism of accommodation—I think the accommodative effort is debilitated excessively by a too liberal use of plus—at near—and as a consequence an ever widening discrepancy is created as between effort and effect of accommodation, with a corresponding discrepancy as between the reciprocal action of accommodation and convergence. This discrepancy manifests itself in the form of exophoria at the working distance in the presbyope.

The foregoing reasoning would seem to me to more logically explain the exophoria of the presbyope than any "lack of positive binocular anchorage. * * *"

"If prism power base in only tends to convert one distressing condition (convergence excess) into another (convergece lag) over a period of years, is it not questionable procedure to use such prism power either for wear, or exercise, without close and constant supervision of the case? Should not the use of such procedure always be accompanied by fusion training?"

I think there is insufficient reliable evidence as yet upon which to base the assumption contained in the first part of this question. The proposition that cases being dealt with on the basis of breaking down old, and building up new, co-ordinations demand close and constant supervision is too obvious to need defending. We have all heard of "the adjustment period"—and in the past we have blandly informed our patients that they must expect this and that unpleasantness during the "adjustment period." This was rather hard on the patient, and certainly unscientific on the part of the Optometrist. Modern methods absolutely demand close and constant supervision, and until much more clinical evidence is before us, from which we might arrive at a reasonably reliable law, most cases of base-in prisms should be watched, and the prescription regarded as "observational."

As to the second part of this question. If the adjustments are rapid, and not attended with undue discomfort to the patient, and if the reactions are in the direction sought by the prescription, then fusion training is less clearly indicated than in those cases where the opposite is true. I think fusion training expedites and facilitates the readjustments in all cases, is less clearly indicated in some cases, and positively necessary in others.

"Is correction of a faulty fusion sense the surest way to estab-

lish comfortable ocular balance? If so, should not all orthoptic training stress the development of greater fusion power?"

It all depends upon which is meant by "*faulty* fusion sense." To my mind "fusion" is the ocular expression of the summation of the adjustive processes evolved in the nervous systems of the body, generally; and specifically (in the matter of "fusion"), in the realm governing clear single simultaneous binocular vision (especially single simultaneous binocular vision and regardless of clearness or comfort). Since there is a multitude of influences serving—or subverting (as the case may be) this end in regions remote from the eye, and since there is a definite and local cerebral realm for the ocular adjustive mechanism, it would appear to me that there is much need for more definite knowledge as to the part played in this summation of adjustive processes by the general and remote influences, as also of the function reserved for the specific nervous ocular influences. Further, since it is clearly established that inhibition and facilitation can be influenced through appropriate discipline ("exercises" * * * following the laws of habit formation through such "exercise") and since all natural processes are aimed at the end result of a higher ratio of effect for a lesser effort (facilitation), we are forced to regard "fusion" as an entity presiding over the stores of kinetic energy available (to the particular mechanism of adjustment) in the interests of ocular "equilibrium" (single simultaneous binocular vision). This kinetic energy is that which permits of the persistency of a "tendency to reaction" after the stimulus has ceased, as distinct from "stored energy" which type of energy is potential and more or less dormant within the organism until called forth by a stimulus. Since "phorias" are "tendencies to reaction," and since "kinetic energy" is the supply house of that nervous demand in order to maintain a persistence of reaction, and since "fusion" is a persistent (if volatile) tendency to maintain equilibrium in the ocular stresses, I think any means that will integrate and facilitate this "persistence tendency" is sound Optometric practice. I do not consider that the development of a high "persistence tendency" (fusion) any substitute for the methods of neutralizing manifest extrinsic and intrinsic stresses by optical means (lenses and prisms), but I do consider that a well integrated and facile "fusion faculty" will definitely contribute to the shortening of the adjustment period, and further, will contribute to comfortable ocular balance in the many and varied demands made upon normal as well as abnormal eyes in this modern age.

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A DIFFERENTIAL DIAGNOSTIC TEST FOR TRUE EXOPHORIA AND EXHAUSTION EXOPHORIA

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The application of base-in prisms for the purpose of inhibiting convergence has instigated fear in the hearts of many Optometrists. The writer can not undertsand just why this should be so. It is easy enough to find a manifest esophoria or a latent esophoria. Orthophoria is, I believe, nothing more than a tendency towards esophoria. It is also easy to find a manifest exophoria but it has not been easy to differentiate between true exophoria and exhaustion exophoria. Many refractionists, including the writer have come across astigmats who wore a cylinder opposite or almost opposite to the ophthalmometer readings. Now that we know what we had, we shall now see how to differentiate and relieve the condition.

Ever since Peckham introduced his brilliant work, much relief can be given these cases. The writer was fortunate to observe a few recent cases, where the cylinder axis was about opposite to that of the ophthalmometer readings. These cases were simple and compound hyperopic astigmatic cases. With the retinoscope neutralization was possible only when the plus cylinder was placed in the incorrect position. Subjectively the plus cylinder was accepted only at the same axis as was worn formerly. When the both eyes were uncovered, a further attempt was made to place each cylinder at about the same axis as determined by the ophthalmometer. Blurred vision resulted. However, the addition of a 1^{Δ} base-in prism gave immediate clear and comfortable vision when the cylinders were placed at about the axis as shown by the ophthalmometer readings. In these cases the 1^{Δ} base-in prism may be incorporated, I believe, in the correction for constant use. Only if base-in treatments are administered may the prism be removed from the correction.

The writer's technique is as follows: After having found the correction for each eye uncover both eyes with the correction in place, and add 1^{Δ} base-in before one of the eyes. Direct the patient to look at the smallest letters he can see on the chart. I have found that if the addition of 1^{Δ} or more base-in causes an apparent enlargement of the test chart characters then the amount of base-in prism that causes the apparent enlargement can be worn constantly with comfort. For example, let us suppose that the final correction is O. U. + 2.00 D. Sph. $\bigcirc$ + 1.00 D. Cyl. axis 90. Uncovering both eyes, the patient is asked to tell if the letters appear to enlarge with

the addition of 1$^{\Delta}$ base-in before one eye. Suppose there is an apparent enlargement with the additional 1$^{\Delta}$ base-in. Suppose also that another ½$^{\Delta}$ base-in causes a further apparent enlargement. If now we add still another ½$^{\Delta}$ base-in and no apparent enlargement is seen, then the last ½$^{\Delta}$ base-in must not be prescribed. The final correction will therefore in this case be:

O. D. + 2.00 D. Sph. ⌒ + 1.00 D. Cyl. axis 90 ⌒ 1½$^{\Delta}$ base-in.
O. S. + 2.00 D. Sph. ⌒ + 1.00 D. Cyl. axis 90.

If the phoria test, shows an exophoria, prism base-in will cause apparent enlargement of the test letters only when there exists an exhaustion exophoria. If a true exophoria exists then no difference in the size of the test letters will be noticed and prism base-in is therefore not indicated. This method is, I believe, a definite means of differential diagnosis between true and exhaustion exophoria.

In conclusion, the following rule may, I believe, be safely followed at all times:

(1) Whenever base-in prism is added to the final correction (keeping both eyes uncovered) and an apparent enlargement of the test letters is thereby caused, all the base-in prism that causes the apparent enlargement may be incorporated in the final correction, giving clear and comfortable vision. This differential diagnosis test I have referred to as the "Sign of Saks."

(2) When the addition of base-in prism causes an apparent enlargement of the image in exophoria, then the exophoria is, I believe, of the exhaustion type. This enlargement will not take place if true exophoria exists.

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THE ENDOCRINE GLANDS AND THEIR CAUSATIVE EFFECT IN THE ANOMALIES OF VISION

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Only about fifty years ago, the endocrine glands—the glands of internal secretion—were merely names to the medical as well as other scientific worlds. Little was known of their structure, nothing of their functions. But since 1884, when the noted Swiss physiologist, "Schiff," published his celebrated paper "on the effects of the removal of the thyroid body" in which he stated his investigations of twenty-five years of the effects of thyroidectomy, the impetus to throw the scientific searchlight upon the glands of internal secretion and study their structure and function was given to the medical, physiologic and psychologic worlds. The introduction at that time of the improved microscope spurned the work yet more with the result that at present some of the glands are entirely under control and their secretions synthetically reproduced in the chemical laboratories.

The importance of the study of the endocrine glands (endocrine is adopted from Greek and means "to separate within") is well expressed by L. F. Barker, Professor of Medicine, Johns Hopkins University, in the following statement: "More and more are we forced to realize that the general form and external appearances of the human body depends, to a large extent, upon the functioning of the endocrine glands. Our stature, the kind of faces we have, the length of our arms and legs, the quantity and location of our fat, the amount and distribution of hair on our bodies, the tonicity of our muscles, the sound of our voices and the size of the larynx, the emotion to which our exterior gives expression—all are, to a certain extent, conditioned by the productivity of our glands of internal secretion."

This study of the endocrines began around 1749 when Theophile de Bordeu, a noted physician of Paris, coined the thought of "gland secretion into the blood." The clarification of the concept of the glands of internal secretion occurred in the first quarter of the nineteenth century. However, no inkling of their real importance to the body, of which quantitatively they form so insignificant a part, was apparently revealed to anyone. Even such men as Henle, the greatest anatomist, and Johann Mueller, the most celebrated physiologist of those days dismissed the endocrine glands as curious nonentities of no real significance to the functions of the body. The first experimental work in the field of the endocrines was conducted by A. A. Berthold and to him goes the honor of being the first experi-

mental demonstrator who proved the reality of a gland with a true internal secretion and the power it exercised through the blood upon the entire organism.

One after another and some of them simultaneously, Claude Bernard, Addison, Brown, Sequard, Bright, Gull, Schiff, Murray, Pawlow, Papielski, Bayliss and Starling, fed the tide of observation of the glands of internal secretion with relevant data. And so under the continuous scrutiny of the three most scientific investigating bodies: the medical, physiologic, and psychologic (the study of behaviorism), the endocrine glands began to yield their thousands of years old secrets, some wholly, like the thyroid, and some partly, like the pituitary or the adrenals, with the result that their functions and secretions are harnessed for the good of human life and happiness.

What is a gland? A gland is a collection of cells—mucous globules—which has the power of taking certain materials from the blood and manufacturing from these raw materials, a product—hormone—which plays a part in the activities of the body as a local effect, or as an effect on the body as a whole. The gland is a kind of a chemical factory.

All glands of the body can be grouped in two classes: the external secretion glands—those that possess ducts by way of which the secretion leaves the gland and the internal secretion glands—the endocrine—those that have no ducts, the secretion being discharged right into the blood.

The second group—the endocrine group—is comprising the following glands:

1. The thyroid—this gland consists of two maroon colored masses usually weighing anywhere between one and two ounces, astride the neck, above the windpipe, close to the larynx and connected by a narrow strip of the same tissue.

2. The pituitary—a piece of grayish-yellow tissue weighing about one-sixtieth of an ounce, the size of a hazelnut, situated in a depression of a wedge shaped bone lying at the base of the skull, a short distance behind the root of the nose. The pituitary gland consists of two halves—the anti and post-pituitary.

3. The adrenals—are two small bodies of a yellowish fatty color, cocked-hat shape affairs, astride the kidneys, one on each side. Each gland is composed of two parts (a) the cortex, outer portion (b) the medulla the inner portion, although no sharp clean cut boundary delimits the two.

4. The Thymus—is a brownish red mass having the spongy effect of sweetbread and is situated in the chest, astride the windpipe, below the breastbone, covering over the upper part of the heart. At birth it weighs about 13.26 gms. but possesses the peculiar characteristic of diminishing with age, so that at the age of 66 it weighs only about 6 gm.

5. The Pineal (Epiphysis) is a cone shaped bit of tissue the size of a pea, hidden in the tiny cave in the base of the brain behind and above the pituitary. Microscopic study reveals that it is made up in part of nerve cells containing a pigment similar to that present in the cells of the retina. This latter was the reason why up to lately it was thought of as the vestigial remnant of a third eye which was situated in the back of the head.

6. The Parathyroids—four in number. Small organs, each about the size of a wheat seed, weighing all four about two grains in all, placed upon the windpipe directly behind the thyroid, two on each side.

7. The pancreas or sweetbread—is a gland shaped like a dog's tongue, weighing about three and a half ounces and having a length of about eight inches. It is situated within the abdomen below the liver and in proximity of the solar plexus.

8. The gonads—or the sex glands also known as the interstitial glands are the ovaries in the female and the testes in the male.

This superficial description of the endocrine glands will have to suffice because, what we, as optometrists, are interested in, is not the morphologic side of the glands, but their physiologic one. What interests us is the manifestation of endocrine activity in the region of the eye and its appendages and their ultimate influence upon vision.

1. The Thyroid gland secretes a substance called by its discoverer, Dr. Kendall of the Mayo Foundation, thyroxin. Through the action of this secretion, the gland became to be known as the gland of energy production and the controller of speed of life. The thyroxin stimulates the metabolic processes, creating the nerve energy necessary for the body for normal functioning. The nerve supply equals the nerve demand and the tonus of the muscle is maintained at normal tension. Excluding pathology, the internal and the external eye muscles are in the orthophoric state. Starting its influence with the impregnated ovum, the thyroid watches over regular and proportionate growth, and naturally, if the other endocrine glands, of which some are synergistic and other antagonistic, are functioning orderly, the happy result will be the emmetropic orthophoric eye.

But as it sometimes happens, the equilibrium of the discharges of the glands is disturbed and the thyroid over-secretes. This condition is known as hyper-thyroidism. The amount of thyroxin increased, the chemical reactions go faster, more oxygen and more material is oxidized or burnt up in a unit of time, more energy is liberated and carried by the nervous system and there is caused an over-excitability of the nerves.

There is in this case always, a superabundant amount of energy at each and every call of the body physiology. When the eye is directed at an object in the act of vision, the superamount of energy may find its way into the intrinsic as well as the extrinsic muscles of

the eye. Is it not possible that this should produce a spasm of the accommodative muscles, creating a simulated myopia, or maybe a pseudoesophoria or pseudoexophoria or any combination of these? The eyes are bright and prominent, large, with a wide awake look, while the pupils are small and contracted. In very extreme cases, this results in the exophthalmic goitre. And although vision in this case is not directly affected, it is indirectly. The lids are not able to cover the whole cornea which then becomes vascular, dry and sometimes ulcerated, from exposure, and vision is almost lost. There is also a paresis of the extrinsic ocular muscles, especially of the abducence.

In the case of hypothyroidism known also as cretinism in children, and myxoedema in grown ups, there is a subnormal discharge of thyroxin. There is a slowing down of chemical processes in the body, with the resultant low ebb of nervous energy and vitality. Stimulus is weak and response very slow, muscles weak and flabby and of low tonicity. A subnormal tone of the accommodative ciliary muscle may bring about a simulated presbyopia. The insufficiency in the extrinsic muscles will cause a convergence or a divergence insufficiency with possible accompanying diplopia or amblyopia. Thyroidism is also an etiological cause for optic neuritis with consequent amblyopia, and may be a rare cause of interstitial keratities.

The thyroid is also the controller of growth of specialized organs and tissues. The eye of the hyperthyroidist is large and "poppy" with the degree of intensity of discharge and inclined by overgrowth to become the myopic eye. On the other hand, the eye of the hypothyroidist—cretin or myxcodema—is the eye, small, deep set, and inclined to hyperopia.

2. While the thyroid is the gland of energy production and bears more directly upon the inner and outer coverings of the body and the irritability, supply, and preparedness for response of the nerves, the pituitary gland is the gland of energy consumption and utilization and acts more upon the framework of the body, the skeleton supports and movers; bone and ligament, muscles and tendon are within its immediate sway. Of the two halves of this gland, the anterior is directly responsible for the growth of the skeleton and supporting tissues, and the posterior controls the tone of the tissues of involuntary or smooth muscle fibres of the blood vessels.

In this case there are four possible direct actions of the pituitary besides the possible combinations of the two parts. Either the anterior may over-secrete or under-secrete or the posterior part may do same and either may be in phase with the other or in non-phase. When the anterior part over-secretes the bones of the skeleton and especially of the cranium, increase in size. As it was brought out by many other writers before, the configuration and size of cranial bones decide the size and shape of the orbital cavities, eye, and its appendages. Naturally the size of the eye in this case would tend to

be of the large eye with a possible inclination to the myopic. Besides, the eyes will be sitting wide apart increasing the interpupillary distance with the possible result of a muscle imbalance of convergence insufficiency.

In a case report of the pituitary by Benjamin Harrow, Ph. D., Associate in Physiological Chemistry, College of Physicians and Surgeons, Columbia University, in his book, "Glands in Health and Disease" we read the following: "The eyes were large, protruding, widely separated, and showed a divergent squint. Six days after the operation, there was an improvement in vision." When the patient reported for observation, he was blind in the left eye and nearly so in the right. The pathologic enlargement of the bones is called acromegaly and the very first symptoms of the sickness are nothing more than eye-strain and dimmed vision caused by a tumor in the gland pressing upon the optic nerve with consequent optic neuritis and optic nerve atrophy. The disease causes also bitemporal hemianopsia and paralysis of one or more of the ocular muscles. Pituitary oversecretion may also cause high blood pressure with diminution of acuteness of vision.

In the state of hypopituitarism, the bones are small, dwarfish. The eye conforming to the orbital cavity is small with predisposition to hyperopia. The smallness and narrowness of the bones bring the eyes in abnormal proximity, decreasing the interpupillary distance and thus maybe creating an esophoria or even an esotropia. As the pituitary is the gland of regulating the consumption of energy, thus being the chief of the inhibitory system, the hypopituatrist cannot dominate his inhibition faculties which may cause him trouble in his fusional activities in the process of binocular single vision.

3. The main action of the cortex of the adrenals is upon the brain cells. In the human being its relative size with respect to the medulla is larger than in any other animal. "Should this preponderance of the cortex over the medullary portion not occur in the human, that is, if the proportions remain like those of other animals, the brain fails to develop properly, or an entirely brainless monster is generated. The human brain, therefore, probably owes its superiority over the animal brain, to the adrenal cortex, in development, anyhow. The growth of the brain cells, their number and complexity is thus controlled by the adrenal cortex." And as vision is ultimated into seeing which is a pure psychological act based upon the ability of the visual memory, which in its turn is dependent upon the size and convolutions of the visual brain area, we can easily divine what extent of influence the cortex of the adrenals has upon the visual faculties of the person.

Besides this, the internal secretion of the adrenal cortex acts upon the pigment cells of the body, blunting their sensitiveness to light. Hyperemia of the conjunctiva, anaesthesia of the retina and

occasional amblyopia would be the sequences of a hypo-condition of the cortex.

Another function of the cortex is that it destroys poisons—either those produced in the course of body metabolism, due to muscular activity (auto-intoxication) or those entering the body from the outside. It is evident then that if the cortex of the adrenal glands is malfunctioning or is in an hypo-secretory state, that visual manifestation due to auto-intoxication would be greatly encouraged in appearing. This may express itself either in a diminution of vision, amplyopia, or even blindness, as well as in a weakening of the functions of the eye muscles both extrinsic and intrinsic with all the possible combinations of their malfunctionings.

The secretion of the second half of the adrenal gland—the medulla—is called adrenalin. The overaction of this gland which pours increased secretion into the blood stream, increases the blood pressure of the body, and there is a tremendous hightening of the tone of the nervous system. The nerve cells become more sensitive to stimuli and the eye sees more clearly. The supply of sugar is increased and the muscles become more full of responsive energy, able to carry on more intensive work and for a longer period. The poisons of fatigue, acid products of contraction of the muscles, are neutralized by the action of adrenalin. But an abnormal increased secretion of the medulla will bring about an hyper-sugar content of the blood which is commonly known as diabetes. The latter is the etiological causative agent of serious eye involvements, as retinitis, iritis, neuritis, paresis of ocular muscles, paralysis of accommodation, cataract and others which are of very grave prognosis for vision.

The nature of the adrenal is, that it may soon break down under continuous strain of over-action and become exhausted. There results a condition of temporary or chronic adrenal insufficiency. There is a lowering of nerve energy with an easy fatigability. The muscles do not respond to stimuli as they should, vision becomes dim and often due to the instability of the hypo-muscle tone, which may express itself in either a phoria or a tropia, blurred and diplopic. The more aggravated condition, the chronic, brings about a nervous breakdown which is known as neurasthenia. It is often accompanied by pain in or around the eyes, aggravated by near use, also fatigue and discomfort in close work. It is also etiologic of heterophorias.

4. Investigations of the influence of the thymus as an endocrine gland although being continuous and many did not discover as yet its true status. It is taken for granted as proven by research that the thymus exerts an inhibitory influence upon certain glands as the thyroid, pituitary and others. Its direct influence upon vision expresses itself in cramps, in the muscles when oversecreting, and in a singular muscle weakness, remarkable fatigability and even atrophy in case of hyposecretion. These conditions—of cramp and weakness —may be the etiological progenitors of all the varied muscular anom-

alies of phorias, tropias, cramps as well as of fusional imbalances, and their sequences in the realm of visual disturbances.

5. The pineal gland is another of the internal gland whose domains are still obscure to the eye of scientific research. It is known as a synergistic co-worker of some of the endocrine glands. Like the adrenal gland the pineal (Epiphysis) has influence with the pigment constituency of our body, thus influencing the degree of reaction to the light ray. Thus "glare" and its vision disturbances would be ascribed to the action of the pineal.

The muscle systems of the body also find themselves under the action of this gland. A set of observations link authoritatively the pineal with a singular muscle shrinking disease, known as progressive muscular distrophy.

Besides the above mentioned spheres of action of the gland, that was for a long time looked upon only as a rudimentry left-over of a once functioning third eye, its involvement is the cause of many various and serious eye troubles. It always causes a marked reduction and failing of vision and is an etiological agent of choked disk, or optic nerve atrophy.

6. The parathyroids are the glands that control the amount of calcium in the system. They are the prime regulators of the amount of lime in the blood and cells. No idiopathic functional over-action of the parathyroids was ever found. The feeding of the extract of the glands when administered in an over-dose results in a "profound hypercalcemia" (Collip Journal Biological Chemistry V. 63-4-5-1925) which causes death.

When the parathyroids are removed or out of action an increase in the excitability of the nerves follow. The reflexes become enormously sensitive, so that merely letting the light into a darkened room will throw the subject into convulsion. These glands play also an important part in maintaining the tone of the muscle and nerve as their absence will cause an unsteadiness of both nerve and muscle. It is very easy to see how this last condition may play havoc with vision and muscular coordination.

7. The pancreas is the controlling force—as a break—of the sugar content in the blood and urine. (Louis Berman—"The Gland Regulating Personality). The matter of retaining sugar and controlling its output is one of utmost significance for growth and metabolism, the resistance to infections, the response to emergency situations, and in general to the mobilization of energy for physical and mental purposes: for without sugar sufficiently at hand for the cells, no muscle work or nerve work are possible."

The hypo-action of the pancreas increasing the amount of sugar in the blood and urine, known commonly as "diabetes" is the most destructive agent of human vision. Charles H. May, "Diseases of the Eye." The common ocular complications of diabetes are cataract and hemorrhages in the retina. Less frequently there occur retinitis,

optic neuritis, retrobulbar neuritis, iritis, paresis of the external ocular muscles, and paralysis of accommodation. Diabetics occasionlly present sudden and marked changes in the state of refraction of the eye, especially myopia, but also hyperopia.

8. As far as the sex glands are concerned, the testes in the male and ovaries in the female, the former in its hypo or hyper activity, has no direct effect upon vision as such with the exception of hightening or lowering the rate of activity of the nervous system. The ovaries in the female are the determining factor of the menstrual period. Their functioning or malfunctioning has written quite a chapter in ocular pathology with involvement of vision. Ocular diseases often show an exacerbation—an increase in the symptoms—in time of menstruation. The latter may also cause asthenopic symptoms as well as weakness of accommodation. Vicarious menstruation is occasionally represented by subconjunctival, vitreous, or retinal hemorrhage. Such ocular diseases as episcleritis, scleritis, intra-ocular optic neuritis and acute retrobulbar neuritis have among their etiological causes, menstrual disorders.

From all aforesaid, which is only the result of a mere scratching of the surface in the question of the influence of endocrine activity upon vision, we may judge of what importance it is to Optometry, a working knowledge of the physiological activities of the internal secretions. The subject is yet very far from being completely explored and its intricacies understood. The rays of sun of scientific research did not break as yet, through the heavy fog concealing same from the mind of the scientific experimenter. But what has been uncovered during the last sixty years of experimental research in this region of endocrine activity should and ought to be taken advantage of, and assimilated with the science of Optometry.

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OCULAR ELECTROTHERAPY

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CHAPTER VII.

THE THERAPEUTIC EFFECT OF HIGH FREQUENCY AND DIATHERMY

In the chapter preceding this one we discussed the different types of current and differentiated betwen high frequency currents and diathermy currents.

High frequency current is a mono-terminal current which is of a high voltage, high frequency and low amperage. This current can not be measured on the milliampere meter. The strength of this current is usually determined by the size of the spark.

There are two methods of applying this mono-terminal current: (1) direct application to the patient through a rubber covered wire and electrode. This wire connects the resonator to a glass or metal electrode which is provided with an insulated handle. The patient thus receives the current from the resonator. The current being applied from the electrode directly to the place to be treated. (2) The indirect method of application is by connecting the patient directly to the wire from the resonator, by a metal hand-electrode. The current is then drawn off from some other portion of the body by the operator by means of applying a grounded electrode.

To use the indirect method effectively, the apparatus should be "tuned" in accordance with the capacity of the patient's body.

Care should be taken that the rubber covered metal wire which connects the patient with the resonator does not come in contact with any metal, in order to avoid current leakage and unnecessary sparking.

Diathermy current is a bi-terminal, high amperage, high frequency and low voltage current. D'Arsonval was the first to show that this current if allowed to pass through the body will produce an increase of temperature in the tissues. While the passage of this current through the body will produce heat, the greatest amount of heat is produced at the points of contact with electrodes. It is only a current which oscillates several hundreds of thousands of times per second that can thus be applied without any disagreeable or painful effects, muscular contraction or any discomfort. The extremely rapid oscillations prevent neuro-muscular effects. While the characteristic of the diathermy current was known since it was discovered in

1890 by D'Arsonval, it was not until 1910 before its therapeutic value was given to the world by Dr. Frantz Nagleschmidt[28] of Berlin and it is claimed that he is responsible for having the name diathermy applied to bi-terminal high frequency current of quantity. He discovered the therapeutic effect of diathermy through an apparatus he designed himself. At the same time, Doyne in his experiments with high frequency currents in the treatment of cancer, found that the normal cells of the body are able to withstand 140° F., and that cancer cells are destroyed by a temperature of between 122°-131° F. In 1912 in his experiments, Lambert found that 114.8° F., destroyed sarcoma cells in 20 minutes. Loebe found that 113° destroyed these same cells in 30 minutes.

The Effects of Diathermy Explained by the Electronic Theory.

Due to the fact that the skin has little or no resistance to the passage of diathermic current, the current passes directly from one electrode to another, heating the tissues that lie between the electrodes. The passage of diathermy through the tissues of the body set up a violent agitation of the electrons of which the tissue is composed.

The heat is formed by the resistance offered to the movement of electrons. That there is some heat introduced into the tissue by the passage of diathermy current is an accepted fact, but the amount is small. The greatest part of the heat is produced by the violent agitation of the electrons of the tissues.

Turrell[29] explains the production of heat by H. F. on the basis of a certain minimal strength and minimal duration. He claims that these two factors are needed in order to excite sensation or muscular contraction; and that if the voltage of the current is increased the minimal duration of an effective current may be reduced. He also claims that the theory of concentration of hydrogen ions at the make and brake of galvanic current affords a reasonable explanation to the phenomena just mentioned. "The same theory," he maintains, "applies with equal force to high frequency currents. If the duration of a current of a certain voltage is below the minimal duration, no contraction will be excited. But if the voltage or strength of the current is greatly increased, a contraction will result with the former minimal duration. The reason for this is evident if we consider that time must be required for the movement, under the influence of the Electro Motive Force, of the hydrogen ions from the electrostatic attraction of the oppositely charged ion. The higher the voltage of the current, the more rapid will this movement be, and consequently the less time will be required to overcome the electrostatic attraction of the oppositely charged ion. If we accept this theory, the atom, whilst in an ionic state, would have its chemical action inhibited by the electrostatic attraction of its oppositely charged associate, but on the application of a sufficient strength to overcome this attraction (hence the minimal strength required), it would be drawn forward

away from this influence, and would immediately and automatically regain its chemical properties. By this theory both the phenomena of minimal strength and of minimal duration are rationally explained."

The therapeutic effects of mono-terminal high frequency current and the bi-terminal high frequency current to be referred to hereafter as diathermy, are of a definite nature and it is important for the operator to remember this difference.

The therapeutic effects of H. F. currents are due to the stimulating counter-irritation which they produce.

The therapeutic effects of diathermy are due to the heating effects produced in the tissues.

The Power of Diathermia Penetration.

It is important for the operator to acquire a knowledge about the power of penetration of the diathermy applied. There is considerable disagreement on this subject amongst authorities as to the amount of voltage and amperage needed to acquire a certain depth of penetration. Eberhart[30] claims that the ordinarily low voltage type of machine which is in general use for diathermy, will cause the current to penetrate up to a thickness of seven inches. For tissues deeper than seven inches the ordinary machine does not possess the power to penetrate. In cases of this type the voltage has to be increased then the heat will penetrate to any desired department. It is regrettable that with the machines on the market now the voltage can not be varied according to the need of the particular case, unless it is a specially built high voltage machine. The milliamperage is the only thing that can be varied at will. It can be increased or decreased as the case my require. Diathermy machines may be manufactured in the future with which it will be possible to vary the voltage according to the need in each particular case. Dosage will then be given in terms of voltage and amperage, instead of amperage alone as is the case at the present time.

Sampson[31] on the other hand insists that high voltage is the first and most important essential in a diathermy machine. The machine which is of a low or medium voltage and high amperage will produce perithermy and not diathermy. *Perithermia* is heating around a resistance area instead of heating *through* it, as is the case with real diathermy. He maintains that it is impossible to take a low voltage machine and use a high voltage technic with it and get the same result in any area having very high resistance in it, as you would by using a high voltage machine. By using this formula: $W = V \times A$ where W = wattage; V = voltage and A = amperage, Sampson shows that the watt (which is the unit of quantity) is obtained directly upon multiplying the voltage times the amperage and when the amperage is raised the voltage is necessarily reduced and vice versa. He claims that in order that a machine may produce satisfactory diathermy, it must have a special built transformer which will

raise the voltage to any point as needed. For instance, if we take a soldering iron and put 10 watts over it, the heating is so small that iron practically remains cold. If we were to put 500 or 1,000 watts over it (this we can only do by increasing the voltage) the heating effect would be considerably increased. One full ampere at 1,000 volts would give us 1,000 watts and one full ampere at 15,000 volts would give us 15,000 watts worth of heat or fifteen times the amount of heat using the same amperage.

In the human body certain parts, such as muscles and bones, offer greater resistance to the current than others and if the voltage is not high enough to drive through the higher resistance layers, then the current will deviate and take the lower resistance paths and the milliamperage will immediately rise accordingly. For instance, if the current is to pass through the shoulder or the thigh and the voltage is too low to drive the current through the bones, the current will take the course of least resistance and pass around the outer tissues. This is what is known a perithermia.

According to this explanation of two diathermy machines used on the same resistance areas, the one giving the lower milliamperage reading is the best.

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A CASE OF PTOSIS IMPROVED BY OCCLUSION

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The following case may be of interest as it is not unusual for the optometrist to encounter cases with more or less Ptosis. Many of these cases become more pronounced as time goes on which makes this case the more interesting.

The child, a girl of 9, with good health and fair mentality was examined April 7, 1928, in the Children's Optometric Clinic with the following findings:

No subjective symptoms.

External examination was negative with the exception of a Ptosis of right upper lid. The internal examination was negative.

Visual acuity: O. D. 15/40; O. S. 15/15.

Ophthalmometer disclosed: O. D. 1½ D. Corneal Astigmia axis 105; O. S., no astigmia.

Static Skiametry: O. D. +0.50 D. Sph. ⊃ +1.50 D. Cyl. axis 105; O. S. +0.50 D. Sph.

Dynamic Skiametry: O. D. +1.25 D. Sph. ⊃ +1.50 D. Cyl. axis 105; O. S. +1.25 D. Sph.

Subjective examination: O. D. +1.50 D. Cyl. axis 105; O. S. +0.50 D. Sph.

Muscles for distance and near appeared in normal balance.

Glasses were prescribed for constant wear with instructions that the left (good) eye be covered 15 minutes before meals during and for 15 minutes after meals as well as one hour each evening.

Child returned on October 27, the Ptosis had practically disappeared, with O. D., accepting +0.75 D. Sph ⊃ +1.50 D. Cyl. axis 105, this giving the patient 15/15 visual acuity.

On January 19th, 1929, the static skiametry findings were: O. D. +2.00 D. Sph. ⊃ +1.50 D. Cyl. axis 105; O. S. +2.00 D. Sph.; and the patient accepted O. D. +1.50 D. Sph. ⊃ +1.50 D. Cyl. axis 105; O. S. + 1.50 D. Sph.; this correction giving normal vision to both eyes.

At this time there was 4° of exophoria present at the near point.

On February 2nd, 1929, this prescription seemed to be satisfactory and all trace of Ptosis has disappeared. Child is to report in June.

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THE TECHNIQUE OF PERIMETRY AND CAMPIMETRY

The word perimetry is used as a general term to apply to the measurement and charting of the visual field. By this is meant the measuring of that portion of the retina that is actually used, directly or indirectly, by the patient in an effort to see. In reality, perimetry is a subjective ophthalmoscopic test. As is well known, ophthalmoscopy is objective; that is, the results of the test depend entirely upon the examiner's ability, while in perimetry one actually charts the field of vision while the retina is at work, relying entirely upon the answers of the patient, thus making it an entirely subjective test. This is our only means of actually knowing whether the sensitive layers of the retina are functioning as they should, inasmuch as the retina may appear normal to the examiner while using the ophthalmoscope, and yet the visual field may be much smaller than normal or various types of scotomata may be present to diminish visual acuity.

To determine the exact field of vision and color perception, the examiner has three general methods of procedure at his command: First, the hand test; second, Campimetry, and third, the Perimetric test proper. I shall describe these various methods briefly in the order named.

The Hand Test

In this procedure, the most inaccurate method of taking the

patient's field of vision, no equipment is needed. The examiners field of vision must be normal, for it is by means of comparing his own field with that of the patient, that the test is carried out. The method of procedure is as follows: The patient is first seated comfortably. The room is well illuminated. The examiner next seats himself directly in front of the patient and at about an arm's length away. Assuming that the examiner wishes to determine the approximate extent of the indirect form field of the right eye, he covers the patient's left eye with his (the examiner's) right hand, at the same time closing his own right eye. The patient is then instructed to look with his right eye straight ahead into the open left eye of the examiner. The examiner then takes some small object—a pencil, for instance—and holds it in his left hand midway between himself and the patient as far out to his left as possible. He then instructs the patient to tell him the moment the moving pencil can be seen, as he draws it in towards him. At all times, I repeat, the patient's direct line of vision must be straight ahead and fixed upon the left eye of the examiner, and the examiner must be looking straight into the right eye of the patient. Now, if at the moment the object becomes perceivable to the examiner the patient also indicates that he is also aware of its presence, the external field of indirect form perception may be regarded as normal in this meridian. The examiner then proceeds to make this test over in various other meridians and then reverses the procedure for the patient's left eye. If the patient's answers conform to the examiner's ability to see the test object, the patient's form field may be regarded as normal. Any marked shrinkage in the size of the field in any of the various meridians tested immediately calls for a more thorough examination of the patient's entire field, as it is easy to see that this test is, at best, quite crude and only suitable for roughly measuring the external limits of the form field. The testing of the patient's field of color perception, and direct visual centers, must be left to the more refined methods of perimetry, such as the following:

Campimetry

The stereo-campimeter is an instrument devised for the purpose of assisting the examiner in the matter of plotting the central visual field. In this purpose the inventor has succeeded very well, for the instrument is, when properly used, highly accurate and easily adjusted. The instrument consists of a substantial metal base of oblong shape, with vertical pillar containing an elevation device, which carries the object stage and holder for the stereo-lens system. This system includes a stereoscopic viewing device and eye screen.

The stereoscopic viewing device just mentioned consists of two prismatic lenses mounted in a frame. These lenses can be rotated to correct any hyperphoria the patient may have, by simply turning a small thumbscrew at the edge of the frame. The lenses can also be

adjusted in horizontal position to assist the patient in getting a clear image of the object stage.

The object stage, as generally used, consists of a black slate ruled with vertical and horizontal white lines. It is upon this slate that the markers are held and the central field of vision plotted.

Campimetry, as this type of perimetry is usually called, is the only form of field taking that is done binocularly. This, in itself, is an immense advantage over the monocular type of procedure, as the average patient finds it much easier to fix his attention on a given point with both eyes than he does with one.

The patient, wearing his distance correction, is seated before the instrument in the best diffused light possible, preferably daylight, and directed to look through the stereoscopic system, which is then focussed, at the campimeter slate. Small test-objects are now moved about upon the slate while the patient's vision is directed to a central point of binocular fixation, which to the patient appears to be in the center of the slate. As the markers are moved about the patient indicates by the tapping of a bell or by some other signal the moment the marker disappears and reappears. With the aid of a white chalk pencil, with which to draw upon the slate, the blind spot and any scotomata present can be definitely located and charted. Thus, the exact workings of a macular area of the retina can be examined and even the smallest defects noted.

Rotating Arc Perimeter

The third form of field taking is that in which the rotating arc perimeter itself is used. Instruments of this character will be found in many of the well-equipped refracting rooms throughout the country, the various makes being about the same and all equally accurate. Most perimeters consist of a metal base, upon which is fastened, at one end, a vertical adjustable chin rest, and at the other end a vertical rod which holds the metal rotating arc, the meridian scale, the carrier drum and adjusting device, and the automatic recording pencil or stylus with sheet.

The instrument is used monocularly, one eye bandaged with an eye patch, the patient being seated in a comfortable manner before the instrument, with head resting upon the chin-rest. The room should be well illuminated, controlled artificial daylight lamps preferred. The perimetric sheet for either the right or left eye, whichever field is being plotted, should be put in place at the rear of the instrument and the patient directed to "fix" upon a small white stationery marker placed directly before the patient's eye at the center of the arc. The arc is now swung into position, most examiners starting in the ninetieth meridian. In taking the form field the five or three millimeter white marker is turned into position on the movable carrier. Now either the "visible to not visible" mode of moving the carrier or the "not visible to visible" mode may be used. If the latter is chosen, the examiner first places the carrier at the

extreme end of the arc and then slowly slides it in along the arc towards th center until the patient indicates that the marker has become visible. The carrier is then stopped and its position on the arc is registered on the perimeter sheet by pressing this sheet against the automatic movable pencil or stylus. This being done in all meridians, the resultant plot will show the exterior edge of the form field of indirect vision. Should the examiner elect to use the "visible to not visible" mode of charting the field, the carrier would be placed at the center of the arc and then slowly moved along the arc until the patient could no longer see it. This many writers believe to be the best method, inasmuch as any large defects of the central portion of the retina could be plotted at the same time that the form field is being taken. The color tests can also be taken in this way, the marker changed to blue, red, yellow or green and the carrier moved from the center along the arc until the color is no longer distinguishable, although in this the writer believes the non-visible to visible method to be preferred. With the automatic recording device, this instrument becomes the most accurate in taking form fields and is of great assistance in enabling the examiner to determine whether the patient's vision is impaired by any pathological defects of the retina.

It is, therefore, apparent that two types of instrument should be used in taking and charting the visual fields if the greatest accuracy and most complete data are desired. Such instruments being the stereo-campimeter, for plotting the central fields, and the rotating-arc perimeter, for plotting the indirect fields.

The diagnostic information to be gained by the use of these field plotting instruments, may briefly be summed up as follows: A concentric contraction of the external limits of the form field as in amblyopia, leutic chorio-retinitis, chronic nephritis, pregnancy, etc., etc.; a hemianops resulting from a diseased condition of the visual tract and chiasm; sector-like defects as resulting from optic atrophy; scotomatas of various kinds due to lesions of the brain, optic tracts, optic nerve or retina, or finally a concentric contraction of the form and color fields, as found in cases of glaucoma as well as in certain cases of toxic poisoning. These are but a few of the many types of ocular pathology which produce changes in the size and form of the visual fields, and as in ophthalmoscopy, it is well for the examiner to remember that any marked change from normal indicates pathology in or around the eye and orbit or an infection or poisoning which is affecting the optic nerve and retina. Cases showing these perimetric diagnostic signs require specialized treatment.

C. C. K.

ABSTRACTS

OCULAR CALISTHENICS FOR PHOTOPHOBIA. L. A. Swann. The Optician, (British). Vol. LXXVI, No. 1961, p. 167. 1928.

Swann credits Savage with the following, claiming that "Savage suggests a method of ocular calisthenics for photophobia. He contends that many cases of photophobia are due to the weakness of the sphincter pupillae which prevents the iris from contracting in bright light. Savage suggests that as the biceps in manual workers become more highly developed through the continued exercise of labor, so the sphincter pupillae will also respond to rhythmic exercises. The exercises are carried out as follows: The patient stands in front of a bright light and shades and unshades his eyes continuouly for ten minutes each day. This causes the pupils to contract and dilate in a rhythmic manner." Swann claims in addition that Savage has cured photophobia by means of this technic.

T. O. B.

SPASM OF THE CILIARY MUSCLE. W. E. Fannon. The Canadian Optometrist. Vol. 10, No. 8, pp. 232-233. 1928.

Fannon claims that a real spasm af accommodation occurs but rarely. He believes that most cases of what are commonly called spasm of accommodation are in reality cases of over development of the ciliary muscle. His reasoning is as follows: The hyperope requiring to use his accommodation at all times to see distinctly, overdevelops the ciliary muscles, more tone is required; the more tone, the larger the muscle develops, with the result that the muscle cannot relax sufficiently to allow the lens to flatten itself enough to allow the full amount of the hyperopia to become manifest. Hence the latent hyperopia. To prove this, it is said that hyperopia can be diagnosed in a dead eye by miscroscopically examining a section of the ciliary muscle. Fannon claims further that the average hyperope cannot wear his full correction with the first pair of lenses and should have frequent changes of lenses until it is found that no more plus can be added.

T. O. B.

ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

The following gentlemen have consented to supply items of interest from their respective sections, acting in the capacity of

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PROGRAM OF AMERICAN ACADEMY

The American Academy of Optometry will hold its annual meeting in Boston, Mass., on December the 15th, 16th, 17th and 18th. The arrangements for this meeting are now being worked out by Dr. Briggs S. Palmer of that city, who is the Chairman of the Arrangements Committee. A detailed report of the plans will be published in an early issue.

An outline of the program as arranged for the four day session is briefly as follows:

Sunday, December 15th: "Chairman's Address," Dr. C. C. Koch, Minneapolis, Minn.; "Field Work," Dr. Howard C. Doane, Boston, Mass.; "The Application of Telescopic Spectacles in Refraction," Dr. Wm. Feinbloom, New York City; "Iridology," Dr. R. W. Bennett, Indianapolis, Ind.

Monday, December 16th: "The Treatment of Myopia and Functional Myopia," Dr. E. F. Tait, Philadelphia, Pa.; "The Physio-Psychological and Philosophical Aspects of Ocular Physio-Therapy," Dr. J. I. Kurtz, Minneapolis, Minn.; "The Treatment of Strabismus," Dr. R. N. Hall, Cleveland, Ohio; "The Secretary's Report," Dr. J. Fred Andreae, Baltimore, Md.; "Report of the Committee on New Instruments," Dr. Walter I. Brown, Bedford, Mass.; "Report of the Committee of Physical Agents in Ocular Work," Dr. J. I. Kurtz, Minneapolis, Minn.; "Mental Processes Worthy of Optometry and Science," Dr. C. R. Padelford, Fall River, Mass.

Tuesday, December 17th: "A Green-Blue-Red Duction Test," Dr. E. LeRoy Ryer, New York City; "Reflected Light and Photography in the Measurement of Strabismus," Dr. E. G. Wiseman, Buffalo, N. Y.; "Results from the Use of Red Free Glass in Incipient Cataract," Dr. E. E. Hotaling, New York City; "Finger Treatment for Correcting Strabismus," Dr. R. W. Bennett, Indianapolis, Ind.

Wednesday, December 18th: "A Study of the Aqueous Humor by means of the Slit Lamp," Dr. Walter I. Brown, Bedford, Mass.; "The Visual Attention Reflex," Dr. R. M. Peckham, Los Angeles, Cal.; "Focal Infections," Dr. James H. Drakeford, New York City; "The Effect of Diathermy on Restricted Color Fields," Dr. H. Riley Spitler, Eaton, Ohio.

In addition to the foregoing papers and reports, there will be a talk at the formal dinner by the 1929 guest speaker whose name is yet to be announced as well as a paper presented by Dr. E. H. Silver of Washington, D. C., the title of which will not be announced until he returns from abroad.

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CALIFORNIA RESEARCH GROUP

Dr. A. Reinke of Oakland, California, announces the formation of the California Research Group in the Science of Vision. The objects of this society are: First, to promote interest, study and research in visual problems; second, to standardize technique of taking and recording data of visual conditions; third, to collect and distribute data pertaining to visual problems to members and associates; fourth, to support and direct trained research fellows in the field of visual sciences.

The first meeting of this group was held May 9th, at the University of California, Optometry School. The following men were elected officers: Dr. F. Wood, President; Dr. J. Mayerle, Vice President; Dr. A. K. Reinke, Secretary, and Dr. N. P. Bradley, Treasurer. At this meeting, Dr. Vance Simonton, dentist, gave a short talk on the relationship of dental infections to the visual color fields.

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MAINE ASSOCIATION MEETS

Dr. S. Baker, optometrist of Rockland, Mass., gave a talk and demonstration of his technic in developing fusion before the Maine Association of Optometrists at its regular meeting held May 22, 1929, at Farmington, Maine.

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DR. BENNETT APPOINTED STATE EDITOR

At a recent meeting of the Executive Committee of the Indiana State Association of Optometrists, the American Journal of Optometry was adopted as the official organ of that organization. Dr. R. W. Bennett of Indianapolis was appointed to represent the Indiana Association on the State Editorial Staff and Dr. Forrest W. Freeman was appointed to the Collaborators Staff.

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